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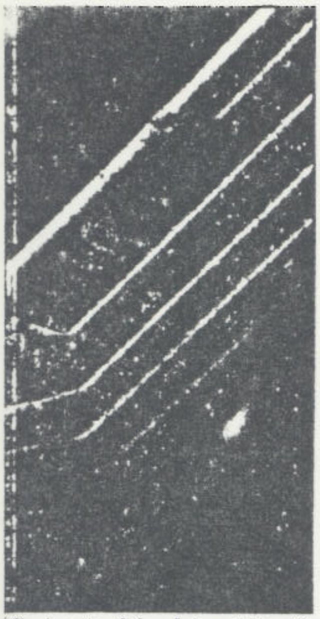

NERVE SENSOR. An implantable silicon probe chip fabricated by a team from the University of Michigan detects the firing of a single neuron.

planted enhancement- and depletion-mode n-MOS process using 6-μm features.

At MIT, researchers use gridlike silicon structures to make intimate contact with the severed peripheral nerves of laboratory animals. David Edell, an assistant professor in the Harvard-MIT division of Health Sciences and Technology and the department of electrical engineering at MIT, says the goal is to develop within five years a "simple, crude" binary data system of use to amputees.

Perhaps MIT's biggest accomplishment to date has been that interfaces between nerves and silicon have been achieved without damaging the nerves. More work is needed to find passivation that would last for a human lifetime so the chips would be appropriate for long-term implants. The MIT group is working on ways to determine the effectiveness of such coatings.

In the area of electrode design, MIT researchers reduced size to improve selectivity but then had to deal with problems of impedance and noise. Now they are using sputtering and electroplating techniques to roughen the electrode surfaces (to increase the surface area of the sensitive region) and for characterization purposes.

Edell says work on peripheral nerves is somewhat simpler than that in the central nervous system. "We're interested in detecting the neural information itself—the action potential" that normally causes a muscle to twitch—"and if you've determined whether the action potential occurs, you've determined all the information."

Detecting action potentials requires a lot less data than analyzing neural activity in the brain. Edell believes data from a severed peripheral nerve could be gathered at 100-Hz sampling rates. "The more we can simplify the electronic signal by electrode design, the simpler detection circuitry will be." He adds that, in the near future, the group will gather human-nerve data through noninvasive techniques. *–Craig D. Rose*

COMPUTER-AIDED DESIGN

CAD SYSTEM TURNS OUT DENTURES IN 30 MINUTES

PARIS

A computer-controlled system that cuts dentures to measure, and in far less time than conventional methods, could ease that lengthy and uncomfortable process. François Duret, who practices dental surgery in Grenoble, put the system together after 15 years of research into computer-aided design.

Using a microcomputer-controlled optical probe of Duret's design, the system translates the three-dimensional form of a patient's mouth into digital information, which the computer then uses to drive a high-precision machine tool to cut dentures. The entire operation takes less than 30 min.

Duret estimates his system can double or triple a dentist's productivity in such operations, at the same time making the procedure easier for the patient. According to Duret, the patient gets a better-fitting denture and gets it immediately: the wait for a handcrafted denture can often take weeks. In addition, Duret's system nearly eliminates the need for adjustments, which Duret believes are the most tedious part of the denture-fitting process.

But the operation is also painless in the economic sense. Duret is convinced that his system will be able to use materials far less expensive than the high-quality porcelain currently standard for an aesthetically pleasing denture and that the cost of the operation for the patient will thus drop significantly.

Hardware for Duret's system consists of a Digital Equipment Corp. MicroVAX II, the optical probe, and a micromilling machine. There are two software modules—one for processing the probe's output signal, and the other for 3-d modeling of the data.

Duret will give few details on the probe, but says it consists principally of a laser-diode source and a charge-coupled-device photoreceptor. After a nonreflective substance is applied to the patient's teeth to eliminate spurious reflections, the probe is passed over the teeth four times. The signal created by the laser light reflected by the teeth and picked up by the CCD array is converted into digital data by the computer's signal-processing software. The computer-aided software module, called Euclid, from Matra Datavision, models the 3-d form and the computer then drives the milling machine to cut the denture.

Duret has attracted enough venture capital to put the system into production next year and has formed a company to market it. *–Robert T. Gallagher*